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document Classical and quantum communication without a shared reference frame Stephen D. Bartlett bartlett@ics.mq.edu.au Department of Physics, Macquarie University, Sydney, New South Wales 2109, Australia Terry Rudolph rudolpht@bell-labs.com Bell Labs, 600-700 Mountain Ave., Murray Hill, NJ 07974, U.S.A. Robert W. Spekkens rspekkens@perimeterinstitute.ca Perimeter Institute for Theoretical Physics, Waterloo, Ontario N2J 2W9, Canada 7 July 2003

abstract We show that communication without a shared reference frame is possible using entangled states. Both classical and quantum information can be communicated with perfect fidelity without a shared reference frame at a rate that asymptotically approaches one classical bit or one encoded qubit per transmitted qubit. We present an optical scheme to communicate classical bits without a shared reference frame using entangled photon pairs and linear optical Bell state measurements.